Estimation of individual growth trajectories when repeated measures are missing

Individuals in a population vary in their growth due to hidden and observed factors such as age, genetics, environment, disease, and carryover effects from past environments. Because size affects fitness, growth trajectories scale up to affect population dynamics. However, it can be difficult to estimate growth in data from wild populations with missing observations and observation error. Previous work has shown that linear mixed models (LMMs) underestimate hidden individual heterogeneity when more than 25% of repeated measures are missing. Here we demonstrate a flexible and robust way to model growth trajectories. We show that state-space models (SSMs), fit using R package growmod, are far less biased than LMMs when fit to simulated data sets with missing repeated measures and observation error. This method is much faster than Markov chain Monte Carlo methods, allowing more models to be tested in a shorter time. For the scenarios we simulated, SSMs gave estimates with little bias when up to 87.5% of repeated measures were missing. We use this method to quantify growth of Soay sheep, using data from a long-term mark-recapture study, and demonstrate that growth decreased with age, population density, weather conditions, and when individuals are reproductive. The method improves our ability to quantify how growth varies among individuals in response to their attributes and the environments they experience, with particular relevance for wild populations.

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Count data can be analyzed using generalized linear mixed models when observations are correlated in ways that require random effects. However, count data are often zero-inflated, containing more zeros than would be expected from the typical error distributions. We present a new package, glmmTMB, and compare it to other R packages that fit zero-inflated mixed models. The glmmTMB package fits many types of GLMMs and extensions, including models with continuously distributed responses, but here we focus on count responses. glmmTMB is faster than glmMADMB, MCMCglmm, and brms, and more flexible than INLA and mgcv for zero-inflated modeling. One unique feature of glmmTMB (among packages that fit zero-inflated mixed models) is its ability to estimate the Conway-Maxwell-Poisson distribution parameterized by the mean. Overall, its most appealing features for new users may be the combination of speed, flexibility, and its interface's similarity to lme4.
The aim of the project is to support the ongoing process of developing long-term management plans for short-lived species of great importance to the Danish fishery and to maintain the international position of Danish fisheries research. The project contains the following objectives: (1) provide a data-driven basis for developing an alternative management model for sandeel in the North Sea, (2) Evaluate a portfolio of management strategies for short-lived species in the North Sea, and (3) contribute with new data to the ICES multi-species model that provide natural mortality estimates to be used in single-species stock assessment models and in relation to an ongoing international effort to take on a holistic ecosystem approach to management. The project also include scientist-stakeholder collaboration and participation in international meeting in EU and ICES. The project is coordinated by DTU Aqua and funded by the European Maritime and Fisheries Fund and the Danish Fisheries Agency.
Maintaining a sustainable sprat fishery in the North Sea (BEBRIS) (39548)
The aim of the project is to support the maintenance of a sustainable sprat fishery in the North Sea, Skagerrak and Kattegat; A fishery of great importance to the Danish industrial fishery. In the project we will be working with the stock assessment model and forecast models (as preparation for the ICES sprat benchmark). In order to support the development of a long-term management, a generic Management Strategy Evaluation tool will be developed according to ICES guidelines. The project will also analyse the role of weather conditions on catchability and distribution of catches. Lastly, the project will look into the possibility of using the IBTS Q3 survey to develop a recruitment index. The project also include scientist-stakeholder collaboration and participation in international meetings.

The project is coordinated by DTU Aqua and is funded by the European Maritime and Fisheries Fund and the Danish Fisheries Agency.

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